Description

FLUID SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

Technical Field

[01] The invention relates generally to fluid systems, and more specifically to a fluid system for actuating subsystems of an internal combustion engine.

Background

[02] Fluid systems are commonly used in machinery and internal combustion engines to perform a variety of functions such as lubricating moving parts and supplying operating muscle for various systems and operations. Typically, a fluid such as oil is pumped from a reservoir and supplied under pressure to a lubrication point, valve or an actuator to perform a specified operation. In the case of internal combustion engines, lubricating oil is used to lubricate the moving parts of the engine and also is used as an actuating fluid to power other systems such as fuel injection.

[03] During operation, an internal combustion engine produces combustion byproducts such as carbon monoxide, oxides of nitrogen, hydrocarbons, sulfuric acid and other particulate matter such as metal fines and the like due to wear of engine components. Over time, the lubricating oil becomes saturated with these contaminants thereby reducing the lubricating properties and the useful life of the oil. The contaminants entrained in the lubricating oil also cause corrosion and unnecessary wear of the internal combustion engine components and other engine systems components that used the lubricating oil.

[04] One approach for combating this problem is disclosed in U.S. Patent 5,676,106 to Hoffman et al. issued on October 14, 1997 and is assigned to the owner of the present invention. The patent discloses extracting small amounts of lubricating oil at controlled time intervals, through the use of a controller, and mixing the extracted oil with the fuel supply. This approach introduces the contaminated oil into the fuel supply so that it can be burnt with the fuel during subsequent combustion cycles. In this manner, the lubricating oil reaches a saturation point and the build up of contaminants is maintained at a predetermined level so that the time frame between oil changes can be extended. Another problem with using lubricating oil is variation in the viscosity of the lubricating oil between cold startup and normal operating conditions.

[05] The present invention is directed at overcoming one or more of the problems as set forth above.

Summary of the Invention

[06] In one aspect of the present invention a fluid system is provided for an internal combustion engine. The internal combustion engine includes a head assembly and has at least one subsystem positioned therein. The fluid system includes a hydraulic fluid and a fluid pump operatively supplying the hydraulic fluid to the head assembly and being used solely for actuating the at least one subsystem positioned in the head assembly of the internal combustion engine.

Brief Description of the Drawings

[07] The sole figure is a schematic representation of an internal combustion engine embodying the present invention.

Detailed Description

[08] Referring now to the sole drawing, a schematic representation of an internal combustion engine 10 is shown. The internal combustion engine 10 is

shown by way of example as being a six-cylinder compression ignition engine or diesel engine.

[09] The internal combustion engine 10 has a head assembly 12 with different subsystems 13 positioned therein. One such subsystem 13 is a hydraulically powered fuel injection system 14. The fuel injection system 14 includes a number of fuel injectors 16 which are provided to selectively inject fuel into an associated engine cylinder (not shown). The fuel injection system 14 of the present invention may be any known fuel injection system, however, one such fuel injection system, which is particularly useful as the fuel injection system 14 is a Hydraulic Electronic Unit Injection (HEUI) system which is commercially available from Caterpillar, Inc. of Peoria, IL.

[10] Hydraulic fluid 18 within a fluid system 20 having a fluid manifold 22 is maintained at a relatively high fluid pressure by a hydraulic pump 24. The hydraulic pump 24 may be driven by the engine 10 and is provided to pump hydraulic fluid 18 from a reservoir 26 separate from the engine lubricating system to the fluid manifold 22. The fluid system 20 also includes a heat exchanger 28, a filter 30 and may also include an electrical resistive heater 32 positioned in the hydraulic fluid 18 stored in the reservoir 26. With the heat exchanger 28, the filter 30 and the electrical resistive heater 32, the hydraulic fluid 18 can be controlled to accommodate desired levels of cleanliness and temperature. The head assembly 12 is completely sealed and hydraulic fluid 18 from the fluid system 20 drains back to the reservoir 26, as is schematically represented in the drawing.

[11] Each of the fuel injectors 16 is fluidly coupled to the fluid manifold 22 such that hydraulic fluid 18 under pressure from the manifold 22 is supplied to each of the fuel injectors 16 and utilized to generate a relatively high fuel pressure within each fuel injector 16. In particular, the engine 10 further includes a fuel system 34, which has a fuel pump 36 for pumping fuel to each of the fuel injectors 16. The fuel within the fuel injectors 16 is further pressurized

via a plunger assembly (not shown), which is driven by the fluid pressure from the fluid manifold 22.

[12] Each fuel injector 16 includes a high speed, solenoid actuated hydraulic valve 38, which is electrically coupled to an engine control module 40 via a wiring harness 42. In such a manner, the engine control module 40 may selectively generate injection pulses which are sent to the individual solenoid actuated hydraulic valves 38 so as to open the valve 38 thereby increasing the fluid pressure exerted on a plunger assembly (not shown) of the associated fuel injector 16 which in turn increases the fuel pressure within the injector 16. Such an increase in the fuel pressure within the fuel injector 16 causes fuel to be injected into the engine cylinder associated with the particular fuel injector 16. It should be appreciated that the engine control module 40 may operate the fuel injectors 16 in wide variety of manners in order to generate injection sequences and operation characteristics, which fit the needs of a given engine 10.

[13] The plurality of subsystems 13 of the head assembly 12 may also include a hydraulically powered exhaust valve actuation assembly 50. For example, the exhaust valve actuation assembly 50 may be a compression release brake assembly 51. The compression release brake assembly 51 includes a number of actuator assemblies 52, which are provided to selectively open the exhaust valves (not shown) associated with the engine 10 when the engine 10 is being operated in a brake mode of operation. Each of the actuator assemblies 52 includes a housing 54 having a piston 56 positioned therein. Each of the actuator assemblies 52 also includes a high-speed solenoid actuated hydraulic valve 58. The solenoid actuated hydraulic valves 58 are similar to the solenoid actuated hydraulic valves 38 of the fuel injectors 16.

[14] The solenoid actuated hydraulic valve 58 selectively couples the housing 54 and piston 56 to the fluid manifold 22 of the fluid system 20. In particular, when the solenoid actuated hydraulic valve 58 is positioned in an open position, pressurized hydraulic fluid 18 is advanced from the fluid manifold 22,

into fluid passages in the housing 54 of the valve 58. The presence of pressurized hydraulic fluid 18 in the housing 54 causes the piston 56 to be urged out of the housing 54 and into an extended position in which the piston 56 is urged into contact with an exhaust valve rocker arm (not shown) or directly with an exhaust valve (not shown). Thus, actuating one or more exhaust valves for each cylinder.

[15] It should be appreciated that operation of the actuator assemblies 52 are under the control of the engine control module 40. In particular, each of the solenoid actuated hydraulic valves 58 is coupled to the engine control module 40 via a wiring harness 60. In such a manner, the engine control module 40 may selectively generate pulses, which are sent to the individual solenoid actuated hydraulic valves 58 so as to open the valve 58 thereby causing pressurized hydraulic fluid 18 to be advanced from the fluid manifold 22 to a fluid side of the piston 56 so as to urge the piston 56 out of the housing 54. Such movement of the piston 56 causes actuation of the exhaust valve thereby allowing gas to be advanced out the associated engine cylinder. Once the exhaust valve has been opened for a predetermined period of time, the engine control module 40 ceases to generate a pulse on the wiring harness 60 thereby causing the particular exhaust valve to be closed.

[16] Additionally, the engine 10 may be an engine that does not require a cam to operate the exhaust or intake valves (neither shown), in which case, the actuator assemblies 52 of exhaust valve actuation assembly 50 would also function to open and close the exhaust valves during normal operation of the engine (i.e. not in brake mode). This type of engine 10 includes an additional subsystem 13 such as an intake valve actuation assembly 70. The intake valve actuation assembly 70 includes a number of actuator assemblies 72, which are provided to selectively open the intake valves (not shown) associated with the engine 10 when the engine 10 is being operated in a normal mode of operation. Each of the actuator assemblies 72 includes a housing 74 having a piston 76 positioned therein. Each of the actuator assemblies 72 also includes a high-speed

solenoid actuated hydraulic valve 78. The solenoid actuated hydraulic valves 78 are similar to both of the previous described solenoid actuated hydraulic valves 38,58.

[17] The solenoid actuated hydraulic valve 78 selectively couples the housing 74 and piston 76 to the fluid manifold 22. In particular, when the solenoid actuated hydraulic valve 78 is positioned in an open position, pressurized hydraulic fluid 18 is advanced from the fluid manifold 22, into fluid passages in the housing 74. The presence of pressurized hydraulic fluid 18 in the housing 74 causes the piston 76 to be urged out of the housing 74 and into an extended position in which the piston 76 is urged into contact with an intake valve rocker arm (not shown) or directly with an intake valve (not shown). Thus, actuating one or more intake valves for each cylinder

[18] It should be appreciated that operation of the actuator assemblies 72 are under the control of the engine control module 40. In particular, each of the solenoid actuated hydraulic valves 78 is coupled to the engine control module 40 via a wiring harness 80. In such a manner, the engine control module 40 may selectively generate pulses, which are sent to the individual solenoid actuated hydraulic valves 78 so as to open the valve 78 thereby causing pressurized hydraulic fluid 18 to be advanced from the fluid manifold 22 to a fluid side of the piston 76 so as to urge the piston 76 out of the housing 74. Such movement of the piston 76 causes opening of the intake valve thereby allowing pressurized fuel to be advanced into the associated engine cylinder. Once the intake valve has been opened for a predetermined period of time, the engine control module 40 ceases to generate a pulse on the wiring harness 80 thereby causing the particular intake valve to be closed.

Industrial Applicability

[19] In use, the fluid system 20 supplies hydraulic fluid 18 to subsystems 13 positioned in the head assembly 13 of the internal combustion engine 10. Specifically, subsystems of the head assembly 12 include the fuel

injection system 14, exhaust valve actuation system 50 and in the event of a camless engine 10 an intake valve actuation system 70. Since the fluid system 20 is isolated from other engine fluid systems, such as an engine lubrication system or a fuel supply system the hydraulic fluid 18 does not have the opportunity to become contaminated with any byproducts of combustion. Additionally, the hydraulic fluid 18 can be controlled at predetermined temperature and cleanliness levels. For example, the filter 30 of the fluid system 20 can be selected to provide a predetermined level of filtration. The heat exchanger 28 and the heater 32 are used to either heat or cool the hydraulic fluid 18 based on ambient operating conditions. The hydraulic fluid 18 may also be selected to have viscosity/temperature properties (i.e. small viscosity changes with temperature change) that minimize the sensitivity of actuator performance to oil temperature. In this case the heat exchanger 28 or heater 32 may not be needed.

[20] Other aspects, objects, and features of the present invention can be obtained from a study of the drawings, the disclosure, and the appended claims.